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Results of the Prices Received by Farmers for Grain - Quality Assurance Project

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RESULTS OF THE PRICES RECEIVED BY FARMERS FOR GRAIN - QUALITY

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ABSTRACT

Reinterview studies were conducted on subsamples of the monthly surveys of prices received by farmers for corn and wheat as part of a quality control program developed to evaluate and improve the accuracy of reported data. The goal of the quality assurance project was to identify reporting errors and to measure the corresponding impact on price levels for corn and wheat.

Subsamples from the monthly Prices Received by Farmers for grain sample were selected from mill and elevator firms that reported purchases of corn in October 1994, and of wheat in July and September 1994. The reinterview samples were selected to provide U.S. level price indications for corn in October and for wheat in July and September.

The Prices Received by Farmers for Grain - Quality Assurance Project proved more useful for evaluating current data collection practices than for evaluating the accuracy of price. Only about one-fourth of the reinterview sample for corn, and two-fifths of the reinterview sample for wheat, reported monthly data that precisely met the particular reporting specifications of this survey for quantity and total gross value.

The two most frequently reported reasons data did not meet reporting specifications were 1) firms reported a total gross value that included price discounts for moisture content and 2) firms could not or would not report quantity adjusted to a standard moisture.

While there were reporting errors, the U.S. level prices for the three commodity/month combinations of interest (corn in October, wheat in July, and wheat in September) obtained from the reinterview study were not significantly different from the original monthly price estimates. This was due in part to the small number of usable records from the reinterview study, resulting in relatively large variances for price.

Several changes for the 1995-1996 marketing year have been implemented based on the results of the Prices Received by Farmers for Grain - Quality Assurance Project. This paper discusses the results of the project as well as some of the changes in specifications, sampling, questionnaire design, and procedures for the prices received program.

These data are administratively confidential and are not to be shared with individuals outside of NASS.

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TABLE OF CONTENTS

SUMMARY	iii
INTRODUCTION	1
Prices Received Surveys	1
Reinterview Surveys	1
Purpose	1
SURVEY DESIGN AND PROCEDURES	2
Sample Design	2
Sample Allocation	3
Survey Procedures	3
ESTIMATION	5
RESULTS FOR CORN	8
Response Rates and Completion Rates	8
Summary of Reporting Error Reasons	10
Price Summary	10
RESULTS FOR WHEAT	12
Response Rates and Completion Rates	12
Summary of Reporting Error Reasons	14
Price Summary	16
DISCUSSION	17
REFERENCES	19
APPENDIX A: Formula for the Variance of the Price Estimator	20

SUMMARY

The National Agricultural Statistics Service (NASS) collects information for prices received by farmers for about 130 major commodities that account for over 90 percent of total farm marketings. Data on grain prices received by farmers are collected monthly from nationwide surveys of mills and elevators. This information is used to estimate the farm prices for grain that determine farm program deficiency payments. Each penny difference in the U.S. corn price estimate makes a difference in program payments of about \$55 million, while each penny for wheat makes a difference of about \$20 million. The accuracy of grain price estimates is therefore extremely important to both producers and taxpayers.

As a result of audits by the Office of the Inspector General (OIG) of NASS' grain and cotton price programs over the past several years, a quality assurance program was put in place to evaluate and improve the accuracy of reported data. It was agreed that OIG and NASS would work together to develop a program for each of the major program crops. Consequently, a quality assurance project was conducted to identify reporting errors and to measure the corresponding impact on price levels for corn and wheat.

Subsamples from the monthly Prices Received by Farmers for grain sample were selected from mill and elevator firms that reported purchases of the commodity of interest in the month to be surveyed. Firms in the October 1994 monthly sample that reported corn purchases were selected for a reinterview study to be conducted in January 1995. Winter wheat samples were selected from firms reporting purchases of wheat in the July 1994 monthly survey, and durum and other spring wheat samples were selected from firms reporting purchases of these commodities in the September 1994 survey. The reinterview samples were selected to provide U.S. level price indications for corn in October and wheat in July and September.

The Prices Received by Farmers for Grain - Quality Assurance Project proved more useful for evaluating current data collection practices than for evaluating the accuracy of price. Less than 25% of the reinterview sample for corn reported monthly data that precisely met reporting specifications for quantity and total gross value. Less than 40% of the reinterview sample for wheat completely met reporting specifications. This indicates that reporting instructions need clarification and communication with the respondents needs to be improved. The most frequently reported reasons data did not meet specifications were 1) firms reported a total gross value that included price discounts for moisture content and 2) firms could not or would not report quantity adjusted to a standard moisture. Other reporting errors included rounding, bookkeeping errors, and deducting marketing expenses in the reported gross value.

While there were reporting errors, the U.S. level prices for the three commodity/month combinations of interest (corn in October, wheat in July, and wheat in September) obtained from the reinterview study were not significantly different from the original monthly price estimates. This was due in part to the small number of usable records from the reinterview study, resulting in relatively large variances for price. State level estimates were also calculated, but no conclusions should be based on these numbers as the goal was to provide a U.S. level price indication. The table below shows the results at the U.S. level for the pilot study, including approximate 95% confidence intervals for the true price.

Commodity	Original Price	True Price	Std. Error (True Price)	95% CI for True Price
Corn (Oct)	2.06	2.08	.0176	(2.04, 2.12)
Wheat (July)	2.99	2.95	.0230	(2.90, 3.00)
Wheat (Sept)	3.60	3.61	.0290	(3.55, 3.67)

INTRODUCTION

Prices Received Surveys

NASS collects prices received information for about 130 major commodities that account for over 90 percent of total farm marketings. Monthly prices are provided for 65 major commodities and marketing year average prices are provided for all 130 commodities (USDA 1994). The NASS farm price generally represents the first point of sale for all grades and qualities. Grain prices are collected from nationwide surveys of mills and elevators while livestock, fruit, and vegetable prices are obtained from a combination of administrative sources and other surveys.

Farm prices are used to generate the cash receipts that go into gross farm income estimates. Farm prices are also used to determine deficiency, disaster, and Federal Crop Insurance payments; determine parity prices; and assist in Government purchase program decisions. In addition, there are many private uses such as the determination of land rental contracts, grazing fees, loan decisions, insurance payments, production decisions, and tax assessments. The accuracy of farm prices is very important since prices for the program commodities have resulted in farm program payments of \$10 billion annually over the past five years (USDA 1994).

Information collected during the monthly Prices Received by Farmers survey is used to estimate the farm prices for grain that determine the farm program deficiency payments. Each penny difference in the U.S. corn price estimate makes a difference in program payments of about \$55 million, while each penny for wheat makes a difference of about \$20 million. The

accuracy of grain price estimates is therefore extremely important to producers and all taxpayers.

As a result of reviews of NASS' grain price programs by the Office of the Inspector General (OIG), a quality control program was put in place to evaluate and to improve the accuracy of reported data. A part of this program included reinterview surveys for corn and wheat.

Reinterview Surveys

The National Agricultural Statistics Service has conducted reinterview studies in the past to evaluate and improve the quality of its agricultural surveys. From December 1987 to 1990, reinterview surveys were conducted for crop acreage, grain stocks, hog inventories, and grain storage (Pafford 1989; McClung, Tolomeo, Pafford 1990; Pallesen 1991). From January 1992 to January 1993, reinterview surveys were conducted for the January Cattle on Feed Survey (Hood 1993, 1992). These reinterview studies allow us to evaluate the quality of the survey instruments as well as the quality of the responses obtained from respondents. Most recently, reinterview surveys were conducted during January 1995 on data collected for corn during the October 1994 monthly survey and during January and February 1995 for wheat data collected during the July and September 1994 monthly surveys.

Purpose

Quality assessment reinterview surveys on prices received by farmers for corn and wheat were conducted for selected months of the 1994 marketing year. The primary purpose of this study was to evaluate the quality of the corn and wheat prices received data obtained through monthly surveys. In

addition to determining levels of reporting error on quantity and value, reasons for reported data not meeting reporting specifications were also identified. Information obtained in these studies will be used to improve data collection processes for the Prices Received Program.

The quality assurance reinterview questionnaire included specific questions about included and excluded items in reported monthly data. As such, it provided a way to check the reporting process versus the instructions. Reconciliation enabled us to identify which of the two sets of figures, the original reported data or the reinterview reported data, was correct, or if a third value was, in fact, closer to the survey's reporting specifications. It also enabled us to identify and document the reasons for differences.

SURVEY DESIGN AND PROCEDURES

Sample Design

The reinterview samples were selected to provide price indications at the U.S. level for corn in October, and for wheat in July and September. Subsamples from the monthly Prices Received for Grain sample were selected from firms that reported purchases of the commodity of interest in the month to be surveyed. In the original monthly surveys, mills and elevators are sampled to determine the quantity purchased from farmers and the total gross value of the purchases for specific commodities. The monthly surveys consist of mail interviews with telephone follow-ups. The reinterview samples were selected as a probability proportional to size (pps) sample using expanded bushels purchased. Thus, a firm's probability of selection was equal to its expanded total quantity purchased (bushels)

divided by the expanded total quantity purchased within that state.

The particular months (October for corn, July for winter wheat, and September for spring wheat) chosen as the reference dates for the reinterview surveys were based on the five month marketing period used in determining deficiency payments. (Prior to the 1994 crop year a five month marketing period was used to calculate a national weighted average market price used in determining deficiency payments. After the 1994 crop year this changed to a twelve month market period.) Historically, these months are among those having the largest marketings for the commodities of interest. While it is true that a few states may have higher marketings in other months, the months selected were considered to be optimal overall for all states.

Using the same month as a common reference for the each commodity had its advantages. Having the States conduct the reinterview survey in the same time frame undoubtedly simplified the coordination of the quality assurance project, which involved twenty-six states. More importantly, spreading the project over several months (for each commodity) would have limited the types of analyses which could be performed. Recall that one of the major goals of the project was to see if there were any differences between the original monthly price and the "true" price derived from the reinterviews. If the project had been spread over different months for each state, a U.S. price could not have been calculated for the reinterview study. Furthermore, as it turned out, several states had no reports or very few reports that met the required specifications. If state level

analysis had been an objective, the project would not have been very productive.

After it was decided what the reference months were to be for each commodity, the next step was to prepare for and conduct the actual reinterview surveys. The reinterview survey for corn was conducted in the following January, and the reinterview survey for wheat was conducted in the following January and February. The delay between the initial interview and the reinterviews did not seem to pose any significant problems to the reinterview and reconciliation process. The information for the prices received surveys involve data that are generally kept in a firm's accounting records. Therefore, bias due to memory recall should not have been a factor.

Sample Allocations

Originally, samples for the corn and wheat reinterview surveys were allocated to states based on a state's expanded bushels purchased (i.e., quantity) as a proportion of the U.S. expanded total quantity. However, this allocation was not satisfactory as some states had too many sample units and other states had none. So that all major states could be included in the reinterview survey, it was determined that a maximum and minimum number of firms should be used in each state. The original pps allocation for the U.S. level sample was used as a basis in setting state level sample sizes. State sample sizes were increased or decreased to fit the constraints of a minimum of 3 and a maximum of 20 units per state. With the total sample size and state level sample sizes determined, pps samples were selected within each state. The probability of a firm's selection within a state was equal to that firm's proportion of the state's expanded quantity (whether corn or wheat). The

reallocation of state sample sizes required that state level estimates be weighted to a U.S. level.

Since the corn and wheat samples were drawn independently of each other, it was possible for some firms to be selected in both samples. Firms that were in both the corn and wheat samples naturally had different sampling weights for the two samples. The goal was to provide price indications at the U.S. level. Sample sizes at the state level were much too small to provide reliable estimates, since most states had only one or two usable records accounting for the expanded quantity and gross value, and the computed price.

Table 1 shows the sample sizes for each state for the two reinterview studies (corn and wheat). The sample for corn consisted of 120 firms that reported corn purchases on the monthly survey in October 1994. The samples for wheat consisted of 90 firms from the July 1994 monthly survey (winter wheat) and 45 firms from the September 1994 survey (durum and other spring wheat) that reported wheat purchases.

Survey Procedures

The Prices Received by Farmers for Grain - Quality Assurance Project followed the same basic procedures as previous reinterview studies conducted at NASS (Hood 1992, Pafford 1989). The current reinterview surveys for prices received consisted of face-to-face enumeration of subsamples from positive reports on the monthly Prices Received for Grain survey. These subsamples were selected from firms that reported purchases of corn in October and for wheat in July or September. The reinterviews were conducted by SSO statisticians from January 5 to February 1

for corn and from January 5 to February 20 for wheat.

Since the goal of the quality assurance project was to check the reporting process versus the instructions, as well as to obtain the most accurate data possible, the person who usually completes the NASS monthly grain prices received by farmers report was contacted when possible. This person would best understand the firm's reporting (and record keeping) practices and would be best

able to help reconcile differences between monthly reported data and reinterview data.

The reinterview process began with an opening statement which stressed NASS' concern for ensuring data quality. This statement emphasized the purpose of the study and the impact of prices received for grain data on farm program deficiency payments. After this opening statement, the reinterview was conducted following the questionnaire order and wording exactly as

Table 1. Sample Allocations for the Prices Received by Farmers for Grain - Quality Assurance Project

State	Corn (October)	Wheat (July)	Wheat (Sept)	Total
AZ	—	3	—	3
AR	—	4	—	4
CA	—	5	—	5
CO	4	6	—	10
GA	3	3	—	6
ID	—	—	7	7
IL	11	7	—	18
IN	9	7	—	16
IA	12	—	—	12
KS	7	11	—	18
KY	7	—	—	7
MI	5	5	—	10
MN	8	—	6	14
MO	7	6	—	13
MT	—	—	7	7
NE	9	8	—	17
NC	6	—	—	6
ND	—	—	9	9
OH	8	8	—	16
OK	—	8	—	8
OR	—	—	4	4
PA	4	—	—	4
SD	7	—	6	13
TX	8	9	—	17
WA	—	—	6	6
WI	5	—	—	5
US	120	90	45	255

written. Immediately after the reinterview was conducted, the reinterview responses were compared to responses from the initial monthly survey and the respondent was asked to help in reconciling any differences. For each difference, the correct response and an explanation for the difference were recorded.

The two data items reconciled during the reinterview were total quantity and total gross value for the commodity of interest. The reinterview questionnaire itself was used to check reporting procedures and the effectiveness of include/exclude components of quantity and gross value questions. The respondent was discouraged from using the monthly survey form in reporting during the reinterview, but was encouraged to use any other available accounting records. This was done to avoid having the respondent quote the same data that was reported for the monthly survey. The purpose of the reinterview was to have the respondent actually go through the questions and the process of determining the true price.

ESTIMATION

The following is a discussion of the process of deriving a proper price expansion formula for the Prices Received by Farmers for Grain Quality Assurance Project. "Expanded value" or "expansion" in the following discussion refers to either quantity or gross value for corn and wheat multiplied by sampling and nonresponse adjustment weights.

The overall sample design consisted of two phases, with the first phase (for the original monthly survey) being a stratified sample within states. The design for the reinterview survey consisted of a probability

proportional to size sample based on expanded quantity purchased as reported on the original monthly survey. Thus, a firm's probability of selection for the reinterview sample was equal to its proportion of the state's expanded total quantity (for either corn or wheat). The expansion consisted of two phases: expansion based on the original monthly survey and an expansion based on the pps sampling for the reinterview.

Initially, I tried to develop an expansion formula for price based on the two stages of sampling and accounting for nonresponse. In order to estimate price (dollars per bushel), both quantity and gross value have to be estimated. The first attempt (Equation 1), a designed based approach, expanded quantity as expected. However, there appeared to be a bias in estimating gross value, and thus also for price. This problem is illustrated in an example below. Because of the apparent biasedness of the first estimator, a model based approach was then considered that led to the ratio estimator shown in Equation 2. This ratio estimator was used in the final summary for both corn and wheat.

Equation 1 shows how a state's expanded total quantity and gross value were initially derived for the reinterview for corn. The states' quantities and total gross value estimates were then summed to get a U.S. level estimate for both quantity and gross value. Price was calculated as total gross value divided by total quantity.

Equation 1:

$$Total = \sum_s \left(x_i * adjexp * \frac{1}{(m_i * n^*)} * \frac{n^*}{n} \right)$$

where

x_i = final "true" value for quantity or gross value

adjexp = first phase expansion factor

m_i = an individual firm's probability of selection for reinterview (measure of size)

n^* = number of firms sampled for reinterview (state level)

n = number of usable records from reinterview sample (state level).

S = reinterview sample

The first phase expansion factor (adjexp)

$$\text{was } \frac{N_1}{n_1} * \frac{A + B + C}{A + B} \text{ where}$$

A = Number of reports containing quantities purchased and dollars for the commodity

B = Number of reports with no grain purchased during the survey month

C = Number of refusals, inaccessibles, etc.

D = Number of operations in the sample that were out-of-business.

E = Number of operations in the sample that do not buy grain from farmers

N_1 = Number of operations in Universe at sampling time

n_1 = Total number of operations in the original sample (A+B+C+D+E).

This formula allows for estimates to be made for quantity, gross value, and price at both the state and U.S. levels. However, there was a small problem in estimating price (total gross value divided by total quantity). If all respondents within a state reported the exact same numbers for both quantity and gross value for the reinterview survey as were reported on the original monthly survey, the "true" price would not necessarily be the same as the original monthly price. This is because the estimator is not unbiased for gross value. While quantity would expand to the same number

(since the reinterview sample was selected pps based on expanded quantity), gross value would not. Let's illustrate this with an example from Minnesota's corn data.

Minnesota had a sample size of eight, but only one report was usable for the corn reinterview. If a state level price estimate was desired, this one report would have to account for the entire state's quantity and gross value. The firm for the usable record reported the exact same gross value and quantity for both the original and reinterview surveys. Minnesota's October corn expanded quantity was 32,203,632 bushels, and expanded gross value was \$62,841,551, resulting in a price of \$1.95 per bushel. The formula above will expand the one record up to the state's original expansion for quantity, but will not for gross value. Gross value expanded to \$54,077,360, resulting in a price of \$1.68 per bushel at the state level.

Consider the following example which illustrates how the pps weights affect the expansion of gross value. Say our universe consists of two observations and a pps sample of size one is drawn based on quantity (just as the Grain Prices reinterview samples were drawn).

Obs	Quantity	Qty Weight	Gross Value	G V Weight
1	10	0.10	20	0.0816
2	90	0.90	225	0.9184
Total	100	1.00	245	1.0000

Assume for simplicity that the first phase expansion factor (adjexp) was equal to 1. If observation 1 is selected for the reinterview sample, then based on Equation 1, $n = 1$ and quantity and gross value expand as:

Quantity: $10 \cdot 1 \cdot (1/0.1) \cdot (1/1) = 100$
 Gross value: $20 \cdot 1 \cdot (1/0.1) \cdot (1/1) = 200$

If observation 2 is selected for the reinterview, the expansions are:

Quantity: $90 \cdot 1 \cdot (1/0.9) \cdot (1/1) = 100$
 Gross value: $225 \cdot 1 \cdot (1/0.9) \cdot (1/1) = 250$

If the whole universe (i.e., observations 1 and 2) are selected for the reinterview sample, $n = 2$ and the expanded values are:

Quantity: $[10 \cdot 1 \cdot (1/0.1) \cdot (1/2)] + [90 \cdot 1 \cdot (1/0.9) \cdot (1/2)] = 100$
 Gross value: $[20 \cdot 1 \cdot (1/0.1) \cdot (1/2)] + [225 \cdot 1 \cdot (1/0.9) \cdot (1/2)] = 225$

Note in all three cases that the expansion for quantity matched the original expansion, but gross value did not match in any case. This illustrates the biasedness of the expansion formula shown in Equation 1.

To verify this, all positive reports from the original monthly samples (the samples that were eligible to be selected in the reinterview sample) for two states (Colorado and Kansas) were expanded using the formula in Equation 1. If the formula is unbiased, we would expect the expanded values using Equation 1 to match the original monthly expansion. The quantity for both states did match up, but the gross value was different for both states. If the estimator is biased for gross value, then a true price cannot be derived.

While the samples were drawn to provide U.S. level indications, this method of expansion produced disturbing state level figures because of the above situation. To remedy this situation, alternative estimation procedures were needed. The final solution

was a method based on a combined ratio estimator. This ratio estimator was used to produce the final estimator for both wheat and corn. The advantage of this estimator is that it will calculate price from expanded data equal to the original price when value and quantity are the same for both surveys, plus it yields a workable variance formula. (See Appendix A for derivation of the variance formula.) This estimator allows for the estimation of quantity, gross value, and price at either the state or domain (July vs. September states) levels. Estimates at the state level do not add to domain estimates because weighting occurs at different levels. Due to the small sample sizes involved no conclusions should be drawn based on state estimates.

The proposed ratio estimator for price is:

Equation 2:

$$p = r_F \cdot \frac{r'}{r} \quad \text{where}$$

Equation 3:

$$r_F = \frac{\sum_F w_i v_i}{\sum_F w_i q_i}$$

which is the original estimated monthly price from the full monthly sample,

Equation 4:

$$r' = \frac{\sum_S \frac{w_i v_i'}{n m_i}}{\sum_S \frac{w_i q_i'}{n m_i}}$$

which is the reinterview estimate of price based on usable records from the reinterview sample

Equation 5:

$$r = \frac{\sum_S \frac{w_i v_i}{n m_i}}{\sum_S \frac{w_i q_i}{n m_i}}$$

which estimates the price using the original monthly data for the usable records from the reinterview sample, where

w_i = first phase expansion factor (adjexp)

q_i = original unexpanded quantity for all wheat

v_i = original unexpanded gross value for all wheat

q_i' = true unexpanded quantity for all wheat obtained during the reinterview

v_i' = true unexpanded gross value for all wheat obtained during the reinterview

m_i = measurement of size - equal to the firm's proportion of the states expanded quantity

n = number of usable records for the reinterview sample within a state.

S = reinterview sample

F = full original monthly sample

RESULTS FOR CORN

Response Rates and Completion Rates

There were 120 reinterview samples selected for the October corn price reinterview survey, for which 113 reinterviews were actually conducted. There were six refusals and one inaccessible

report. Of the 113 reinterviews that were conducted, only 22 fully met reporting specifications for both quantity and gross value and were ultimately usable for summary. Table 2 shows the number of samples per state and the percentage of samples that were complete and usable.

Table 3 shows the response coding for the reinterview and reconciliation forms for corn. Also shown is whether or not the combination of codes was usable and the associated frequencies.

Of the 113 reinterviews that were conducted, 101 were complete and usable. Of the remaining twelve, two were incomplete and ten were complete but not usable for summary. The ten reports were not usable because the data was pulled from the monthly questionnaire, violating the assumption of independence between the initial and reinterview responses. Data were still collected for these records in order to capture as much information as possible for reviewing reporting procedures.

For a record to be usable for price summary, **both** the quantity and the gross value used to derive the price had to be usable. From the 101 independently completed reinterviews, 79 firms were able to report a quantity that met reporting specifications and 22 firms were able to provide a gross value that met reporting specifications.

These 22 firms provided both quantity and gross value reinterview data meeting specifications for summary. For 11 of these 22 usable records, the original October data were deemed to be accurate.

Table 2. Response Rates for the October Corn Price Quality Assurance Survey

State	Sample Size	Completed	Response Rate (%)	# Usables	Usable % (Completed)
CO	4	2	50	1	50
GA	3	2	67	0	0
IL	11	7	64	1	14
IN	9	9	100	1	11
IA	12	11	92	2	18
KS	7	5	71	3	60
KY	7	5	71	1	20
MI	5	5	100	2	40
MN	8	8	100	1	13
MO	7	4	57	0	0
NE	9	8	89	3	38
NC	6	6	100	0	0
OH	8	8	100	1	13
PA	4	4	100	1	25
SD	7	7	100	0	0
TX	8	6	75	4	67
WI	5	4	80	1	25
US	120	101	84	22	22

Table 3. Response Coding of Reinterview and Reconciliation Forms

Reinterview Response Code	Reconciliation Response Code	Usable?	Count	Percent of Reint Sample
Partial/Incompl	Partial/Incompl	No	2	2
Refusal	Refusal	No	6	5
Inaccessible	Inaccessible	No	1	1
Not Indep Reint	Not Indep Reint	No	10	8
Complete	Complete	Yes	22	18
Complete	Complete	No	79	66

Summary of Reporting Error Reasons:

A summary of why differences occurred between initial and reinterview responses and why records did not meet reporting specifications for quantity and gross value for completed reinterviews is provided in Table 4. The counts represent the number of firms that reported a particular reason when a difference occurred or when the firm was unable to meet reporting specifications.

The "# Reported" column shows the total number of times the monthly figure was incorrect either due to error or because the reporting specifications could not be met. The "# Usable" column shows how many times the problem was reconciled to obtain a reinterview figure that was accurate and met reporting specifications.

Price Summary

Table 5 compares the original expanded monthly values to the "true" expanded values obtained via the reinterview process. Estimates are given at both the state and U.S. levels. Note that some states are not estimated for, as they had no reinterview records that were usable for price summarization. The records in these states either did not meet reporting specifications or were not completed reinterviews. The state estimates *do not sum* to the U.S. figures, because a combined ratio estimator was used to estimate the quantity, value, and price at the different levels.

Based on 22 usable reports, the price received by farmers for corn sold in October was \$2.08 per bushel, which was two cents higher than the original October price. However, this was not a significant

difference. Due to the combination of small sample size and small number of usable records, the variance for the "true" price was relatively large. The standard error for the original October corn price was \$0.0055, while the standard error for the "true" price (from the reinterview-reconciliation process) was \$0.0176. Appendix A has a discussion on how the variance for the "true" price was calculated.

In order to see how the two leading reasons that data did not meet reporting specifications (price discounted for moisture and quantity unadjusted to standard moisture) affected the U.S. price, two more summaries were considered. First, records that were usable for quantity (adjusted to a standard moisture) but not usable for gross value because price was discounted for moisture were summarized with the 22 usable records. The reinterview value was used as the "true" response for gross value for the 36 records that fell into this category. The U.S. price for these 58 (22+36) records was \$2.06 per bushel. Next, six more records were added to the 58. These six records were reports that had price discounted for moisture and were also not usable for quantity because they reported quantities unadjusted to standard moisture. The reinterview response was used as the "true" value for both quantity and gross value for these six records. (There were no records that reported quantity unadjusted to standard moisture but with usable data for gross value.) The U.S. price based on these 64 records was \$2.07 per bushel. Again, none of the differences between original price and reinterview price were significant.

Table 4. Number of Firms Reporting Specific Reasons for Reporting Errors: Corn

Reasons for Quantity	# Reported	# Usable
Reported quantity unadjusted (wet) to standard moisture and could/would not report at standard moisture (shrunk)	17	1
Bookkeeping was not up to date for monthly survey	10	9
Math or bookkeeping error	6	6
Purchases from other elevators, brokers, and non-US farmers included	5	4
Some or all of the needed contract purchases were excluded	5	3
Rounding difference	4	4
Respondent said the telephone recorded data was in error	4	4
Detailed records kept at firm's Headquarters. Respondent does not have access to all data needed to comply with reporting specs	3	2
Reported sales for the month rather than purchases	1	1
Reported wrong month's data	1	1
White corn purchases were excluded	1	1
Screenings included	1	0
Reasons for Gross Value	# Reported	# Usable
Values does not meet specs because moisture discounted	43	0
Marketing expenses deducted in the reported gross value of all purchases	16	1
An average price was used to calculate gross value for monthly survey	13	4
Quality discounts were not deducted from the Total Gross Value	9	2
Some or all of the needed contract purchases were excluded	4	2
Rounding difference	3	3
Purchases from other elevators, brokers, and non-US farmers included	2	2
Bookkeeping not up to date when monthly data is collected	2	1
Math or bookkeeping error	1	1
Detailed records kept at firm's Headquarters. Respondent does not have access to all data needed to comply with reporting specs	1	0

Table 5. Comparison of Price for Corn (October)

State	October Quantity	October Dollars	October Price	True Quantity	True Dollars	True Price	Difference (True-Orig)
CO	7,312,301	16,445,558	2.25	7,312,301	16,445,558	2.25	0.00
GA	2,963,482	7,087,819	2.39	—	—	—	—
IL	190,519,146	385,902,915	2.03	190,519,146	385,902,915	2.03	0.00
IN	102,513,801	202,706,617	1.98	102,513,801	202,706,617	1.98	0.00
LA	129,178,535	259,215,408	2.01	129,178,535	261,073,496	2.02	0.01
KS	38,807,793	87,957,618	2.27	39,213,649	89,069,552	2.27	0.00
KY	19,878,785	41,683,948	2.10	17,809,370	39,302,922	2.21	0.11
MI	5,307,470	10,490,066	1.98	4,701,701	9,595,687	2.04	0.06
MN	32,203,632	62,841,551	1.95	32,203,632	62,841,551	1.95	0.00
MO	17,355,118	35,233,901	2.03	—	—	—	—
NE	94,988,412	201,682,507	2.12	94,988,412	203,768,415	2.14	0.02
NC	12,043,438	27,761,702	2.30	—	—	—	—
OH	84,960,926	167,515,448	1.97	84,960,926	167,515,448	1.97	0.00
PA	3,813,909	8,879,531	2.33	2,357,453	5,483,844	2.33	0.00
SD	16,467,135	28,816,683	1.75	—	—	—	—
TX	35,221,248	89,610,468	2.54	59,157,094	147,074,304	2.49	-0.05
WI	7,365,396	15,224,100	2.07	7,350,117	15,198,816	2.07	0.00
US	800,900,527	1,649,055,840	2.06	772,226,138	1,606,837,169	2.08	0.02

RESULTS FOR WHEAT

Response Rates and Completion Rates

Table 6 shows the response rates for the July and September wheat reinterview surveys. There were 135 samples selected for the July (90) and September (45) wheat reinterviews. A total of 125 reinterviews were conducted. There were eight refusals and two inaccessible reports. Of the 125 reinterviews conducted, 115 were complete (independently completed from reported monthly data) with a corresponding 204 reconciliation forms. A separate reconciliation form was completed for each type of wheat for which data is collected.

Thus, the number of reconciliation forms is greater than the number of reinterviews.

Totals for wheat were derived by summing the figures for the different types.

Table 7 below shows the frequencies of various combinations of response coding for the reinterview and reconciliation forms for July and September wheat. Also shown is whether or not the combination of codes was usable for price summarization.

Of the 125 reinterviews that were conducted, 115 were completed independent reinterviews. There were four incomplete reinterviews. Six reinterviews were completed but not used in summary because

Table 6. Response Rates for the July and September Wheat Price Reinterview Surveys.

State	Sample Size	Completed	Response Rate %	No. of Usables	Usable % (Completed)
July Wheat States					
AZ	3	2	67	0	0
AR	4	2	50	2	100
CA	5	4	80	2	50
CO	6	4	67	2	50
GA	3	1	33	0	0
IL	7	6	86	1	17
IN	7	7	100	1	14
KS	11	9	82	8	89
MI	5	4	80	1	25
MO	6	5	83	1	20
NE	8	8	100	1	13
OH	8	8	100	0	0
OK	8	5	63	3	60
TX	9	7	78	4	57
September Wheat States					
ID	7	7	100	2	29
MN	6	6	100	1	17
MT	7	7	100	1	14
ND	9	9	100	5	56
OR	4	2	50	1	50
SD	6	6	100	1	17
WA	6	6	100	5	83
US	135	115	85	42	37

Table 7. Response Coding for Reinterview and Reconciliation Forms

Reinterview Response Code	Reconciliation Response Code	Usable?	Count	Percent of Reint. Sample
Partial/Incompl	Partial/Incompl	No	4	3
Refusal	Refusal	No	8	6
Inaccessible	Inaccessible	No	2	1
Not Indep Reint	Not Indep Reint	No	6	4
Complete	Complete	No	73	54
Complete	Complete	Yes	42	31

the data were taken directly from the original monthly questionnaire and therefore not considered independent of the original response.

For a record to be usable for price summary, **both** the quantity and the gross value used to derive the price had to be usable. From the 115 independently completed reinterviews, 90 firms were able to report quantity per reporting specifications and 42 firms were able to provide a gross value figure that met reporting specifications. These 42 firms provided both quantity and gross value reinterview data meeting specifications for summary.

Summary of Reporting Error Reasons:

A summary of the reasons why differences occurred between initial and reinterview responses and why records did not meet reporting specifications for quantity and gross value are provided in Table 8. The

counts are based on unique reports of reasons within a firm. That is, if a firm reported the same reason for three classes of wheat, the reason was counted only once. However, if a different reason was reported in each case then all three reasons would be counted for that record. Thus, these counts represent the number of firms that reported a particular reason when a difference occurred or when the firm was unable to meet reporting specifications.

The "# Reported" column shows the total number of times the monthly quantity figure was incorrect either due to error or not meeting reporting specifications. The "# Usable" column shows how many times the problem was reconciled to obtain a reinterview figure that was accurate and met reporting specifications.

Table 8. Number of Firms Reporting Specific Reasons for Reporting Errors: Wheat

Reasons for Quantity	# Reported	# Usable
Reported quantity unadjusted (wet) to standard moisture	20	16
Math or bookkeeping error	11	11
Purchases from other elevators, brokers, and non-US farmers included	9	6
Rounding difference	8	8
Some or all of the needed contract purchases data were excluded	7	2
Bookkeeping not up to date when monthly data is collected	4	4
Wheat classes were combined - monthly survey asks for them separately	2	2
Respondent said telephoner's recorded data was in error	2	2
Reported sales for the month rather than purchases	1	1
Detailed records kept at firm's Headquarters. Respondent does not have access to all data needed to comply with reporting specifications.	1	1
Reported wrong month's data	1	1
Delayed pricing contracts were included	1	1
Wheat purchases for resale as seed were included	1	0
Firm derives quantity by dividing gross value by posted price	1	0
Reasons for Gross Value	# Reported	# Usable
Value does not meet specs because moisture is discounted in price	44	0
Marketing expenses were deducted in the reported total gross value	14	4
An estimated price was multiplied by quantity to derive total gross value	10	2
Math or bookkeeping error	7	7
Purchases from other elevators, brokers, and non-US farmers included	6	4
Some or all of the needed contract purchases data were excluded	6	1
Rounding difference	5	5
Bookkeeping not up to date when monthly data is collected	3	3
Quality discounts were not deducted from the total gross value	3	2
Respondent said the telephoner's recorded data was in error	3	2
Freight charge to Portland was included in total gross value	2	2
Reported sales for the month rather than purchases	2	2
Wheat purchases for resale as seed were included	2	0
Wheat classes were combined - monthly survey asks for them separately	1	1
Delayed pricing contracts were included	1	1

Price Summary

Table 9 compares the original expanded monthly values to the "true" expanded values obtained via the reinterview process. Estimates are given at both the state and combined state levels. Note that there were no usable reinterview reports for Arizona, Georgia, and Ohio. The records in these states either did not meet reporting

specifications or were not complete reinterviews. Table 10 compares the original U.S. monthly price estimate and the "true" price for the July and September wheat samples. The "true" price was not significantly different from the original monthly price.

Table 9. State Level Wheat Prices for Records Meeting Reporting Specifications.

State	Monthly Dollars	Monthly Quantity	Monthly Price	True Dollars	True Quantity	True Price	Difference (True-Orig)
July Wheat States							
AZ	4,074,505	917,132	4.44	—	—	—	—
AR	12,914,254	4,245,174	3.04	12,914,254	4,245,174	3.04	0
CA	25,447,049	7,522,602	3.38	12,438,029	4,385,413	2.84	-0.54
CO	33,674,128	11,153,083	3.02	31,254,700	9,976,273	3.13	0.11
GA	1,742,636	566,476	3.08	—	—	—	—
IL	67,373,851	23,528,702	2.86	67,373,851	23,528,702	2.86	0
IN	45,633,173	15,992,455	2.85	46,526,860	16,499,849	2.82	-0.03
KS	249,874,470	82,713,556	3.02	247,617,448	82,824,736	2.99	-0.03
MI	26,294,943	8,678,506	3.03	26,294,943	8,678,506	3.03	0
MO	26,723,588	9,384,119	2.85	26,234,532	9,384,119	2.80	-0.05
NE	67,236,640	22,097,548	3.04	66,490,743	22,097,548	3.01	-0.03
OH	137,429,167	47,039,503	2.92	—	—	—	—
OK	35,539,315	11,727,641	3.03	33,041,938	11,218,140	2.95	-0.08
TX	40,657,779	13,295,573	3.06	40,628,897	13,295,573	3.06	0
September Wheat States							
ID	57,885,773	16,112,647	3.59	57,903,230	16,112,558	3.59	0
MN	22,711,642	6,993,977	3.25	22,711,642	6,700,944	3.39	0.14
MT	45,293,206	13,492,037	3.36	22,611,452	6,777,780	3.34	-0.02
ND	152,122,031	41,562,099	3.66	128,282,392	35,110,019	3.65	-0.01
OR	21,688,613	5,381,807	4.03	19,993,798	5,333,033	3.75	-0.28
SD	33,132,555	9,717,637	3.41	23,309,400	6,832,803	3.41	0
WA	45,729,966	11,850,016	3.86	44,435,181	11,513,170	3.86	0

Table 10. Combined State Level Wheat Prices for Records Meeting Reporting Specifications.

Domain	Monthly Price	True Price	Std. Error (True Price)	95% CI for True Price
July States	2.99	2.95	0.023	(2.90, 3.00)
Sept States	3.60	3.61	0.029	(3.55, 3.67)

Small sample sizes and small numbers of usables resulted in relatively large variances for both the July and September reinterview samples. The standard error for the original July monthly price was \$0.0055, compared to \$0.023 for the "true" price. The standard error for the original September monthly price was \$0.025, compared to \$0.029 for the September reinterview sample.

In order to see how price discounted for moisture and quantity unadjusted to standard moisture affected the U.S. price, another summary was considered. Records that were not usable because the firm either reported quantity unadjusted to standard moisture content or because the firm reported a gross value that included discounts for moisture were summarized with the usable records. A substitute final "true" value for these nonusable records was determined by reviewing each record carefully. There were 31 records that fell in this category for July wheat. These 31 records plus the 26 usable records yielded a price of \$2.96 per bushel. Again, this was not significantly different from the original price. There were 13 records for September wheat for which final values could be obtained. These 13 plus the 16 usable records yielded a U.S. level price of \$3.59 per bushel, which was not significantly different from the original monthly price.

DISCUSSION

Several changes to the Grain Prices Received Survey Program have been implemented based on the results of the Prices Received by Farmers for Grain Quality Assurance Project. These include changes in specifications, sampling, questionnaire design, and procedures.

SPECIFICATIONS:

Previously, when firms reported the total gross value of a commodity purchased from farmers, any price discounts for moisture were supposed to be added back in before total gross value was reported. Permitted price discounts include low test weight, foreign matter, damage, or low protein content. If the reporting firm could not provide a value which included the price discounts for moisture added back in, then technically the value did not meet reporting specifications. Beginning with the 1995-1996 survey cycle, gross value will be acceptable when the firm reports a value that includes price discounts for moisture content if the reported quantity purchased is shrunk to standard moisture. This should provide substantially more usable reports, since the number one reason records did not meet reporting specifications was because price had been discounted for moisture content. None of the firms that reported discounts for moisture content were able to provide the

gross value with the discount for moisture content added back in, since, in most cases, they did not dry the grain and drying charges were therefore not itemized. Firms still must report quantities adjusted to standard moisture content in order to meet reporting specifications.

SAMPLING:

Beginning with the 1995-1996 marketing year, new grain price samples will be implemented only in July and October. Previously, new sample implementation was state dependent and spread over six different months. The thirty-four monthly grain price states will be split into two groups: a Small Grains Group consisting of twenty states that will implement their new samples in July; and a Feed Grains and Oilseeds Group consisting of fourteen states that will implement new samples in October. This change will allow NASS to more efficiently organize and support statistically defensible quality assurance procedures for the monthly prices received surveys.

PROCEDURES:

The agency is re-emphasizing its procedures for all states to personally contact all firms in the sample prior to the first data collection of the marketing year. This initial interview is conducted to get the cooperation of the firm's management, to verify the reporting unit, and to determine if the firm can report price data to meet the particular specifications for these surveys, within a tolerance. Some firms' accounting systems do not record all the information needed to fully answer some questions of the survey, and thus are not able to meet all specifications. Respondents for these firms are requested to estimate the necessary "adjustments" to components of quantity and gross value. Excluding all reports that

cannot precisely meet every reporting specification may introduce more bias on survey results than including these "adjusted" reports. Guidelines on tolerance levels have been provided and each state should establish levels with each firm where necessary. Recontact of firms with "special reporting" instructions is required periodically during the sample year.

QUESTIONNAIRE:

Several changes have been made to questionnaires for the 1995-1996 survey cycle. The initial interview questionnaire has been redesigned to establish an operation profile for each firm in the sample. The operation profile documents the reporting unit and the firm's ability to report data per specifications. The monthly grain price questionnaire has been changed to enhance clarification of reporting instructions and to document reporting of the include/exclude components of the questionnaire. This checklist of include/exclude questions will be used during the editing process to make sure the reported data is within the reporting tolerances.

RECOMMENDATIONS:

Barring any resource and respondent burden constraints, I would make only two general recommendations based on the results of this pilot study. First, at some point, another reinterview study (with larger sample sizes) could be conducted to determine what effects, if any, the above changes have made on the ability and compliance of firms to report quantity and value to the specifications required for these surveys. Second, the areas that were major causes of reporting errors (firms reported a total gross value that included price discounts for moisture content, and firms could not or

would not report quantity adjusted to a standard moisture) should be investigated further, either through additional reinterview studies, or through follow-up studies designed to address specific problems, or through follow-up with those firms where such reporting problems were discovered at the time of the initial interview.

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APPENDIX A: Formula for Variance of the Price Estimator

Recall that the “true” price was estimated by $p = r_f * r'/r$ where

$$r_F = \frac{\sum_F w_i v_i}{\sum_F w_i q_i}, \quad r' = \frac{\sum_S \frac{w_i v_i'}{n m_i}}{\sum_S \frac{w_i q_i'}{n m_i}}, \quad \text{and} \quad r = \frac{\sum_S \frac{w_i v_i}{n m_i}}{\sum_S \frac{w_i q_i}{n m_i}}$$

and w_i = first phase expansion factor (adjexp)
 q_i = original unexpanded quantity for all wheat
 v_i = original unexpanded gross value for all wheat
 q_i' = true unexpanded quantity for all wheat obtained during the reinterview
 v_i' = true unexpanded gross value for all wheat obtained during the reinterview
 m_i = measurement of size - equal to the firm's proportion of the states expanded quantity
 n = number of usable records for the reinterview sample within a state.

Let $y = r_f$ and $x = r'/r$ so that $p = y * x$. Now y and x are nearly unbiased estimators of their respective targets, Y and X . Furthermore, it is not unreasonable to assume that they are also uncorrelated. Consequently, $MSE(p) \doteq Y^2 MSE(x) + X^2 MSE(y)$, where MSE denotes mean squared error. We have nearly unbiased estimates for Y , X , and $MSE(y)$. Thus, we can estimate $MSE(p)$ once we estimate $MSE(x)$. To this end, let

$$e_i = \frac{w_i}{nm_i}, \quad \text{then } x = \frac{r'}{r} \text{ where } r' = \frac{\sum_S e_i v_i'}{\sum_S e_i q_i'} \text{ and } r = \frac{\sum_S e_i v_i}{\sum_S e_i q_i}.$$

Furthermore, let $Q = E(\sum_S e_i q_i)$, $Q' = E(\sum_S e_i q_i')$, $R = \frac{E(\sum_S e_i v_i)}{Q}$, and $R' = \frac{E(\sum_S e_i v_i')}{Q'}$.

Now,

$$\begin{aligned} x - X &= \frac{r'}{r} - X = \frac{r' - Xr}{r} \doteq \frac{r' - Xr}{R} \doteq \frac{\left(R' + \frac{\sum e_i (v_i' - q_i' R')}{\sum e_i q_i'} \right) - X \left(R + \frac{\sum e_i (v_i - q_i R)}{\sum e_i q_i} \right)}{R} \\ &= \frac{\frac{\sum e_i (v_i' - q_i' R')}{\sum e_i q_i'} - X \frac{\sum e_i (v_i - q_i R)}{\sum e_i q_i}}{R} \doteq \frac{\frac{\sum e_i (v_i' - q_i' R')}{Q'} - X \frac{\sum e_i (v_i - q_i R)}{Q}}{R} \doteq \sum d_i^* \end{aligned}$$

$$\text{where } d_i^* = \frac{\frac{e_i(v_i' - q_i' R')}{Q'} - X \frac{e_i(v_i - q_i R)}{Q}}{R}.$$

Given that $E\{d_i^*\} = 0$, we can, in principle, estimate the MSE of the price with

$$V^* = \frac{n}{n-1} \sum_s \left[d_i^* - \left(\frac{\sum d_i^*}{n} \right) \right]^2.$$

$$\text{Since } d_i^* \text{ is unknown we replace each } d_i^* \text{ with } d_i = \frac{\frac{e_i(v_i' - q_i' r')}{\sum_s e_i q_i'} - X \frac{e_i(v_i - q_i r)}{\sum e_i q_i}}{r}.$$

$$\text{This gives us } MSE(p) = \frac{n}{n-1} \sum_s \left[d_i - \frac{\sum d_i}{n} \right]^2.$$

$$\text{Observe that } \sum_s d_i = 0. \text{ Thus, } MSE(p) = \frac{n}{n-1} \sum_s d_i^2.$$

This estimator of the MSE can also be written in a slightly more workable form as

$$MSE(p) = \frac{n}{n-1} \sum_{i=1}^n [a_i'(v_i' - r'q_i') - a_i(v_i - rq_i)]^2$$

$$\text{where } a_i' = \frac{\frac{e_i}{\sum e_i q_i'}}{\frac{\sum e_i v_i}{\sum e_i q_i}} \text{ and } a_i = \frac{\frac{e_i}{\sum e_i q_i}}{\frac{\sum e_i v_i}{\sum e_i q_i}}.$$

